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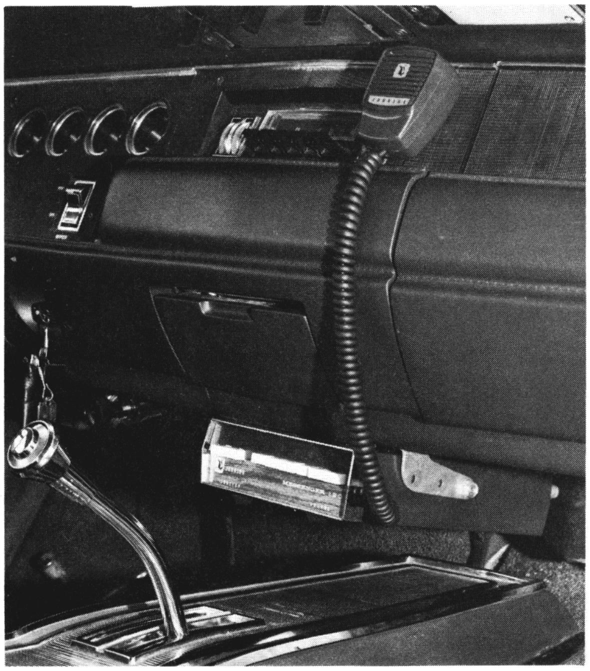
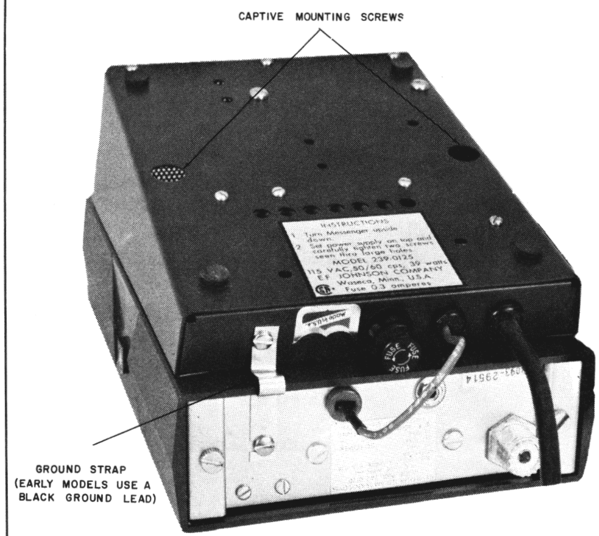


TYPICAL MOBILE INSTALLATION
FIGURE 3-1



BASE STATION INSTALLATION
FIGURE 3-2

3.3 BASE STATION INSTALLATION

3.3.1 ANTENNA AND TRANSMISSION LINE INSTALLATION

The quality and type of antenna installation determines if a transceiver will operate at its maximum capability.

a. Select the antenna type and location which fits the particular base station requirement.

   1. Make sure the location, height and type of antenna are adequate for the intended use of the base station.

b. Select the proper transmission line type for the particular installation requirement.

   1. Connect the transmission line from the antenna to the transceiver. Keep the line as short as possible for maximum efficiency.

3.3.2 AC POWER SUPPLY INSTALLATION

a. Attach the AC Power Supply, Part No. 239-0125-001, to the transceiver and connect the transceiver for proper base station operation. Refer to Figure 3-2.

   1. Position the transceiver upside down on a flat surface.

   2. Place the power supply on the transceiver, line up the screw holes with captive screws and tighten the screws.

   3. Connect the ground lead or strap from a number 8 screw on the transceiver rear panel to a number 8 screw on the power supply.

3.4 FINAL CHECKOUT

a. Connect a Bird Model 43 with 10A element or equivalent wattmeter into the transmission line.

b. Adjust the antenna for best VSWR following the manufacturers instructions. The transceiver has been aligned at the factory and the output network will not normally require tuning to match it to the antenna. The measured VSWR should be 1.5 to 1 or less.

c. Check the transmitter power output. Typical power output is 3.5 watts.

d. Check the transmitter frequency with a frequency meter. The maximum allowable tolerance from the center frequency is ±0.005%.

e. Check the modulation. Minimum acceptable is 80% upward and downward (70% for tone modulation). A suggested method is outlined in Section 5.

f. Give the transceiver a complete operational checkout. Make several contacts with other units in the system and correct any noise suppression problems that affect transceiver performance.

3.5 NOISE SUPPRESSION

Vehicle electrical noise of some sort is a problem in almost all new mobile radio installations.

a. Before beginning any special noise suppression steps, be sure that the vehicle is well tuned. Clean and tighten all electrical connections, including alternator, battery, regulator and coil connections. Perform the following maintenance steps as necessary:

   1. Solder crimped spark plug and distributor leads.

   2. Clean and regap or replace spark plugs and ignition points.

   3. Check and clean alternator rings and brushes.

   4. Retune the engine every 10, 000 miles or twice a year, whichever occurs first.

b. Ordinarily several sources of noise are present in any vehicle, with the strongest covering the others. Drive to a relatively quiet location (free of man-made electrical interference such as noisy power lines, industrial noise or other vehicles.

c. Test for ignition noise with a weak signal or no signal on channel. Vehicle may be standing still. Ignition noise will be present at all engine speeds and, if severe, may make a normally readable signal unreadable. Ignition noise is a "popping" sound which varies with engine speed. It stops immediately when the ignition key is turned off with the engine at a fast idle.

d. A "whining" noise which varies with engine speed and continues with the ignition turned off with the vehicle coasting in gear is characteristic of the alternator.

   1. Check and clean the alternator rings and brushes.

e. An irregular "clicking" sound which disappears at a slow idle characterizes the voltage regulator.

f. Irregular popping noises which vary with road surfaces indicate static discharge at any of several locations in the vehicle.

   1. Tighten loose nuts and bolts, and bond large areas such as the fenders and exhaust pipe to the frame with heavy lengths of braid.

g. The E. F. Johnson Company offers a noise suppression kit, Part No. 250-0801-001, which can be ordered from the Johnson dealer or distributor. This kit is useful in reducing noise from the voltage regulator and the alternator or generator. The Champion Spark Plug Company offers, free of charge, an excellent publication on noise suppression, "Giving Two-Way Radio Its Voice".

To obtain this publication, write to:

Automotive Technical Services Department
Champion Spark Plug Company
Toledo, Ohio 43601

SECTION 4
CIRCUIT DESCRIPTION

4.1 GENERAL

The Messenger 120 is a solid state five channel citizen band radio transceiver, which incorporates a single tone selective calling section. Refer to the operating manual for operating details.

The key to understanding the sequence of operation is the position or operating condition of the call and stby switches.

Refer to the block diagram and transceiver schematic when following this circuit description.

STANDBY CONDITION

When the standby (stby) button is pressed (self-latching), the transceiver responds only to calls from other transceivers on the same channel using the proper alerting tone frequency.

The operation sequence is as follows:

a. The incoming alerting tone is passed by the receiver and coupled from noise limiter CR3 by coupling capacitor C11 to closed contacts 6 and 4 of S1B.

b. The alerting tone is coupled from contact 4 of S1B through closed contacts 8 and 10 of S1A to the first audio amplifier, Q7.

c. Contact 3 of S1B connects to contact 5, opening squelch gate Q6, allowing the first audio amplifier, Q7, to conduct.

d. The alerting tone is amplified by first audio amplifier Q7 and audio driver Q8 and then coupled from the collector of Q8 through closed contacts 9 and 11 of S1B to the selective calling section.

e. Standby tone output from Q105 of the selective calling section is coupled through closed contacts 12 and 10 of S1B to audio output stages Q9 and Q10, then to the speaker.

f. The processed standby tone output also controls the multivibrator, Q106 and Q107, which turns on call light DS101.

OPERATE CONDITION

After an alerting tone has been received, pressing the call button unlatches (deactivates) the stby button. This allows the transceiver to switch to the operate condition, which permits voice communications with the calling station.

The operation sequence is as follows:

a. +10 VDC is applied to the receiver section through closed contacts 1 and 3 of S1A.

b. Voice output from audio switch CR9 is applied to the first audio amplifier, Q7, through closed contacts 2 and 4 of S1B and 8 and 10 of S1A.

c. Selective tone alert input is opened with contact 9 connecting to 7 of S1B.

d. Tone oscillator feedback loop is opened with contact 9 connecting to 7 of S1A.

e. Audio driver output is coupled to the audio transformer, T6, through closed contacts 8 and 10 of S1B.

f. +12.6 VDC audio return is applied to the speaker through closed contacts 4 and 2 of S1A.

g. Call light is reset with contact 3 connecting to contact 1 of S1B.

CALL CONDITION

When the call button is momentarily pressed, the selective calling section keys the transmitter and modulates the transmitter RF carrier with an alerting tone (call tone) frequency.

The operation sequence is as follows:

a. Contact 5 connects to contact 3 of S1A, removing the +10 VDC line from the receiver stages, which deactivates the receiver.

b. Contact 6 connects to contact 4 of S1A, applying +12.6 VDC to the transmitter stages, which activates the transmitter.

c. Contact 9 connects to contact 11 of S1A which connects the tone feedback loop between Q102-Q103 and Q101. This allows Q102-Q103 to function as a tone oscillator, with the call tone output being coupled through closed contacts 12 and 10 of S1A to the base of Q7.

d. The call tone is then amplified by Q7, Q8, Q9, Q10 and coupled to Q12 and Q13 where it modulates the RF carrier.

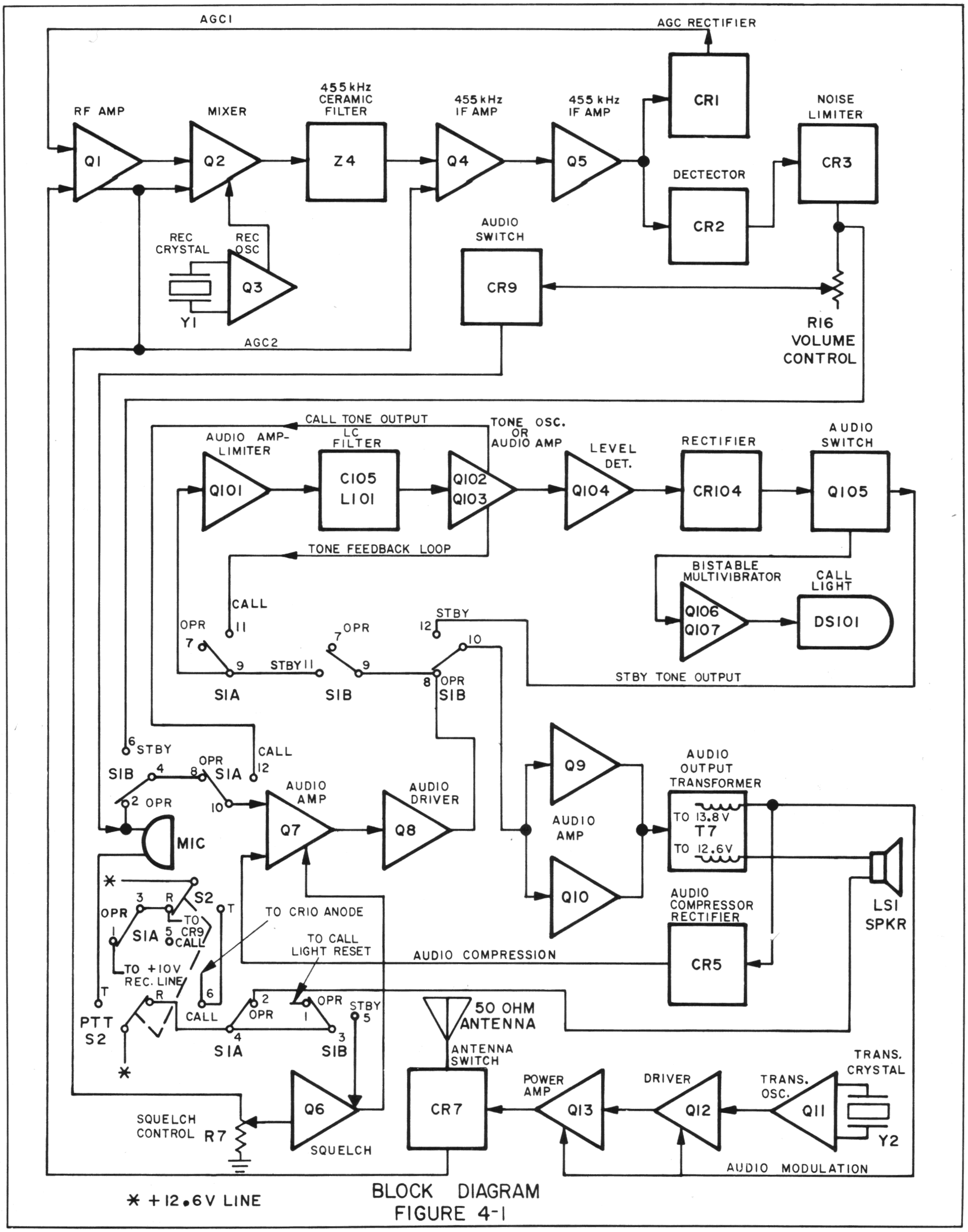
RECEIVE TO TRANSMIT SWITCHING

When switching from receive to transmit operation, antenna switching diode CR7 switches the antenna while the push-to-talk (PTT) switch, S2, switches the operating voltages from the receiver to the transmitter section.

4.2 RECEIVER

4.2.1 RF SECTION

The RF signal is coupled from the antenna through a low pass pi filter network consisting of C42, C41, L4, C40, C39 and L3; through C37 to RF input transformer T1.



BLOCK DIAGRAM
FIGURE 4-1

NOTE: Switches are shown in the operate position.

RF input transformer T1 provides impedance matching and couples the RF signal to the base of RF amplifier Q1, where it is amplified and then coupled by RF output transformer T2 to mixer Q2.

Low side signal injection from oscillator Q3 is coupled to the emitter of Q2, where it is mixed with the RF signal. The resulting 455 kHz difference signal is then coupled to the ceramic filter, Z4.

Oscillator Q3 operates as a modified Colpitts type, with provision for selection of up to five different crystals.

IF, DETECTOR AND NOISE LIMITER

The mixer output is coupled to the 455 kHz ceramic filter, Z4. After the 455 kHz signal is filtered by Z4, it is then amplified by IF amplifiers Q4 and Q5. IF gain control R2 can be set to adjust IF gain. Refer to the Alignment Section for proper R2 adjustment.

The amplified 455 kHz IF signal is detected by CR2. Noise limiting is accomplished by CR3 and associated components.

The resulting noise limited audio signal is coupled by coupling capacitor C11 to volume control R16.

4.2.3 AUTOMATIC GAIN CONTROL (AGC)

A sample of the second IF amplifier output is coupled by C5 to a rectifier filter network consisting of CR1, R3 and C6. This network develops a voltage (designated AGC1) which connects to the base of Q1. When the received signal level increases, a negative going voltage is applied to the base of Q1, which effectively reduces its gain.

When Q1 gain is reduced, an amplified AGC voltage (designated AGC2) is coupled from the emitter of Q1 to the base of Q2 and Q4, which effectively reduces their gain.

When the received signal level decreases, Q1 gain is increased, which in turn increases the gain of Q2 and Q4.

The end result of AGC1 and AGC2 action is a relatively constant audio output with varying RF signal inputs.

4.2.4 AUDIO

The audio signal is coupled from the wiper arm of volume control R16 by coupling capacitor C51 to audio switch CR9, which is biased "on" in the receive condition. From CR9, the audio is coupled by coupling capacitor C50 to first audio amplifier Q7 (with switches S1A and S1B in operate position).

The audio is amplified by first audio amplifier Q7 and audio driver Q8, and then coupled by audio driver transformer T6 to the class B audio output stage, Q9 and Q10.

The audio output from Q9 and Q10 is coupled by audio output transformer T7 to the speaker, LS1. External speaker jack J1 is available for use with an accessory external speaker.

4.2.5 SQUELCH

The squelch circuitry consists of squelch gate Q6, squelch control R7 and associated components.

Squelch gate Q6 is normally reverse biased (cut off), which connects a positive going collector voltage to the emitter of first audio amplifier Q7. This forward biases Q7, enabling audio output.

When squelch control R7 is adjusted to forward bias squelch gate Q6, it conducts and a negative going collector voltage is applied to the emitter of first audio amplifier Q7. This reverse biases Q7, disabling audio output.

When an RF signal of the proper amplitude is received, the emitter voltage of RF amplifier Q1 goes in a negative going direction. This reverse biases squelch gate Q6 and forward biases first audio amplifier Q7, enabling audio output.

4.3 TRANSMITTER

4.3.1 OSCILLATOR AND RF

Transmitter oscillator Q11 is a modified Colpitts type, which utilizes third overtone crystals to produce low level RF signals. Temperature compensation is provided by capacitors C30 and C31. Transformer T8 adjusts the oscillator frequency and couples the RF signal to the base of RF driver Q12.

RF driver Q12 raises the RF signal power to a sufficient level to drive power amplifier Q13. Transformer T9 couples the driver output to the base of power amplifier Q13.

Power amplifier Q13 is operated Class C and designed to operate with a 5 watt DC power input for a power output range of 3 to 4 watts. The antenna is switched from receive to transmit operation by diode CR7 and the power output is coupled through a low pass filter network to the antenna.

4.3.2 MODULATOR AND AUDIO COMPRESSOR

Audio signals from the microphone are coupled to the base of first audio amplifier Q7 where the signals are amplified. Audio switching diode CR9 is biased "off" in transmit condition and effectively isolates the receiver circuitry from the first audio amplifier input.

The amplified audio signals are coupled from the collector of first audio amplifier Q7 to audio driver Q8.

The audio signal is then amplified and coupled by audio driver transformer T6 to the Class B audio output stage, Q9 and Q10. The audio output is coupled by audio output transformer T7 to RF driver Q12 and power amplifier Q13, modulating the RF carrier.

Audio compression is provided by sampling the audio output at the T7 secondary. This audio sample is coupled by C25 to the compressor rectifier diode, CR5. After rectification, it is filtered by RC filter R20 and C22 and applied to the emitter of Q7, which is then biased for less audio gain. This audio compressor circuit maintains a relatively constant modulation output with a varying microphone audio input.

4.4 SELECTIVE CALLING

4.4.1 RECEIVE OPERATION

The following circuit description presupposes that the standby (stby) switch button is depressed. Refer to section 4.1 for switching details.

Audio output from the receiver audio driver, Q8, is coupled to the base of amplifier-limiter Q101, located in the selective calling section. Q101 is biased so that the input signal always drives it into saturation. The output of Q101 is a negative going square wave of constant amplitude which is coupled through R107 to an LC filter. The LC filter consists of C105 and L101, with filter tuning being accomplished by adjustment of L101. Plug in components C105 and R107 are selected for the desired filter frequency range. Refer to Table 1, located on the schematic diagram, for the frequency determining element values. The sine wave output from the filter is applied to a very high input impedance (approximately 10 megohms) Darlington audio amplifier Q102-Q103. The audio amplifier output is then coupled by tone bandwidth control R113 through C106 to the base of the level detector, Q104. Diodes CR101, and CR102 provide voltage regulation and temperature compensation for the bias of Q104. The bandwidth control is set for a level which allows Q104 to conduct on tone frequencies within ±25 Hz from the system tone frequencies. This adjustment in addition to the LC filter action, determines the ability of the selective calling section to reject off frequency tone signals. Also, the combination of C107 and R119 provides an RC time constant which mutes the call tone during approximately the first second of an incoming tone to reduce falsing.

Negative going output pulses from Q104 are coupled by C108 to the half wave rectifier, CR104. The negative DC voltage developed across R122, the result of the rectifying action by CR104, turns Q106 off. The bistable multivibrator, Q106 and Q107, under no signal input conditions, normally allows Q106 to conduct with Q107 cut off. When this input signal turns Q106 off, Q107 becomes forward biased and conducts. Call light DS101 turns on and the Q107 collector voltage is dropped across DS101. This removes the reverse bias from audio amplifier switch Q105, allowing it to conduct. The audio output from Q104 is then amplified by Q105 and coupled by C103 to the standby tone out line. The combination of R123, C110 and the setting of time delay control, R129, provide a time constant of approximately 3 seconds before the bistable multivibrator switches and turns on the call light and Q105. This long time constant and the selectivity of the device help prevent false triggering. The multivibrator and call light are reset by depressing the call button, or by depressing the off button and then the channel selector button.

4.4.2 TRANSMIT OPERATION

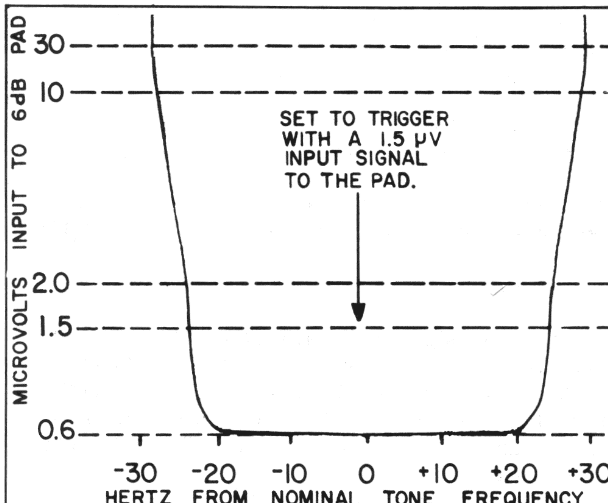
The following circuit description is with the call switch button depressed. Refer to the call condition section for switching details.

When the call button is depressed, a feedback loop between Darlington amplifier Q102-Q103 and amplifier-limiter Q101 is closed. This allows Darlington amplifier Q102-Q103 to function as a tone oscillator. The feedback loop path is from the collector of Q102-Q103 through R112 and C102 to the base of Q101. The sine wave tone output (modulate) is coupled from the emitter of Q103 through R110 to receiver first audio amplifier Q7.

4.4.3 FALSE TRIGGERING

In order to trigger the selective calling section, a received 0.75 μV tone signal must be within ±25 Hz of the nominal tone frequency for 4 or more seconds.

False triggering is sometimes possible because no single tone signaling system can be completely free from false triggering. For example: If a beat frequency (difference between the frequencies of two RF carriers) is within ±25 Hz of the tone frequency and lasts long enough, it will trigger the selective calling section. One of the most common times for this beat frequency to occur is when another transmitter, using borderline crystals, is first keyed. This allows the transmitter oscillator to drift onto its operating frequency, often sweeping across the channel frequency. If this beats against another transmitted signal, the resulting beat frequency could trigger the selective calling section. Refer to Figure 4-2 for a typical selective calling bandpass curve.



TYPICAL SELECTIVE CALLING BANDPASS

FIGURE 4-2

NOTE: The selective calling section is set to trigger with a 1.5μV input signal (to attenuator pad) which is within ±25Hz of the selective calling nominal frequency.

SECTION 5
SERVICING

5.1 GENERAL

The information in this section serves as a guide for servicing the Messenger 120 Transceiver. Carefully read this information before attempting to isolate transceiver malfunctions.

Refer to the circuit description, block diagram and schematic to familiarize yourself with the transceiver circuitry.

Always give a defective transceiver a quick visual check before attempting to isolate troubles. Look for overheated or discolored components and cold solder joints. Be suspicious of solder joints that appear to have excessive solder, too little solder, or dull and uneven color.

5.1.1 PREVENTIVE MAINTENANCE

The transceiver should be put on a regular maintenance schedule and an accurate record of its performance should be maintained. Important checks are receiver signal-to-noise, transmitter power output and frequency and selective signaling section frequency. Use the performance tests in the alignment section as guides.

5.1.2 SOLDERING PRACTICES

The same basic soldering practices used on other printed circuit boards can be used on the Messenger 120 printed circuit board. Avoid using small wattage soldering irons and apply the amount of heat that will cause the solder to flow quickly. No soldering iron smaller than 47 watts should be used. Use desoldering devices such as a solder sipper or solder wick to remove solder from the printed circuit board.

5.1.3 COMPONENTS LAYOUT

A components layout sheet is located at the back of this service manual. The view is from the bottom of the printed circuit board and is printed on a transparent page. It can be referenced to the actual printed circuit board when locating components, measuring voltages and performing signal injections.

5.1.4 REPLACEMENT PARTS LIST

A replacement parts list has been included at the back of this service manual. The parts are listed in alphabetical and numerical order for ease of location. Refer to Table 1 on the schematic diagram for a tabulation of tone frequency determining elements.

The transistors used in this transceiver are specially selected for specific parameters and are listed with E. F. Johnson part numbers. To obtain peak transceiver performance, replacement transistors should be the type listed in the parts list section.

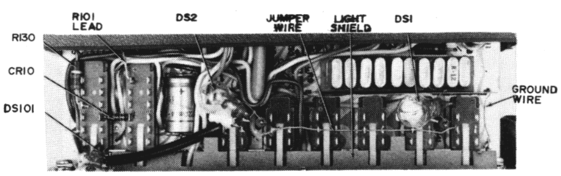
5.1.5 OSCILLOSCOPE WAVEFORMS

When servicing the selective signaling section, it is recommended that an oscilloscope be used. Refer to the schematic diagram for the appropriate oscilloscope waveforms.

5.1.6 CALL, STBY AND CHANNEL SWITCH REPLACEMENT

If one switch section becomes intermittent or defective, we recommended replacement of the entire switch bank. Refer to Figure 5-1 and proceed as follows for switch bank replacement.

1. Refer to the components layout and unsolder all switch connections. Use a desoldering device to remove solder from connections. Tag leads.
2. Remove the transceiver front panel. Remove the fiber light shield. Remove the volume and squelch control mounting bracket from the printed circuit board.
3. Unsolder the forward end of the receiver oscillator coaxial lead and disconnect lights DS1, DS2 and DS101.
4. Gently pull up on the switch bank and remove it from the printed circuit board.
5. Remove switch knobs, diode CR10 and the jumper wire from the old switch bank, and connect them to the replacement switch. Remove lights DS1, DS2 and DS101.
6. Install the replacement switch and resolder. Install and solder items in steps 2, 3 and 5.



SWITCH REPLACEMENT
FIGURE 5-1

5.2 TRANSISTOR TROUBLESHOOTING

5.2.1 GENERAL

The following information is intended to aid troubleshooting through the isolation or elimination of transistor malfunctions.

It should be pointed out that a transistor which checks good, even with an expensive tester, might not function properly in the circuit. Transistor substitution should then be the final judge of transistor condition. However, because of the excellent history of transistor reliability, don't substitute a transistor before being certain that other components are not causing the problem.

Transistor lead placement is not always consistent. Therefore, transistor base diagrams should be consulted when there is doubt.

5.2.2 TRANSISTOR OPERATING CHARACTERISTICS

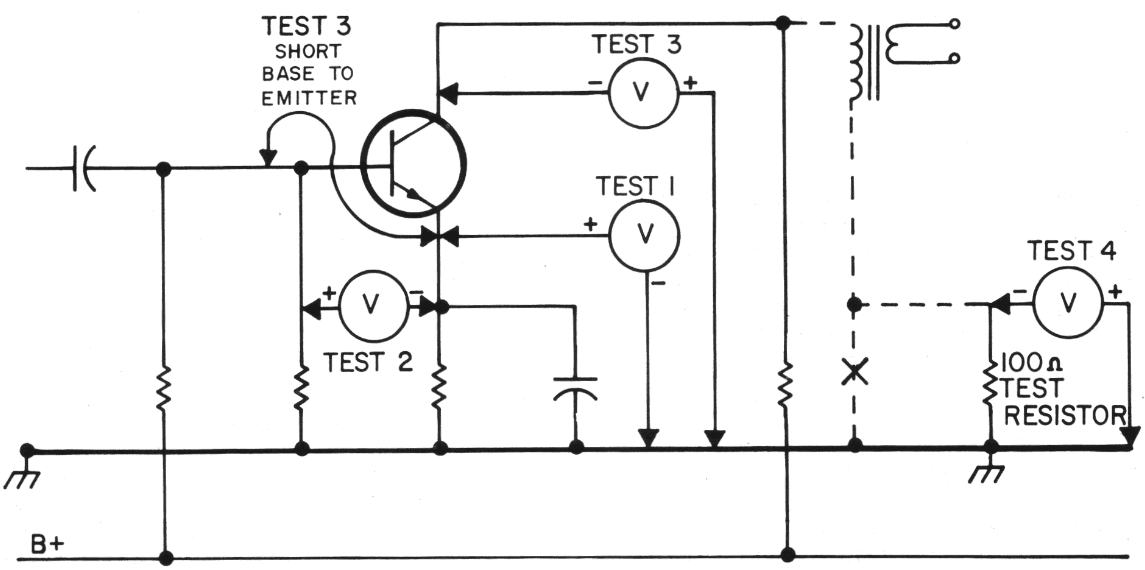
For all practical purposes the transistor base-emitter junction and the transistor base-collector junction can be considered to be diodes. For the transistor to conduct, its base-emitter junction must be forward biased in the same manner as a conventional diode. In a germanium transistor the typical forward biased junction voltage is 0.2 to 0.4 volts. A typical silicon transistor will have a forward biased junction voltage of 0.5 to 0.7 volts. When collector current is high the base-emitter voltage of both germanium and silicon transistors increases from 0.1 to 0.2 volts. The base-emitter bias voltage in the forward biased condition is then 0.4 to 0.5 volts for a germanium transistor and 0.7 to 0.9 volts for a silicon transistor. High current silicon transistors may go up to 2 volts under load.

5.2.3 IN-CIRCUIT TRANSISTOR TESTING

An in-circuit transistor tester should be used if one is available. If one is not available, an in-circuit transistor test can be performed using a sensitive voltmeter, a soldering aid and, sometimes, a 100 ohm resistor.

Refer to Figure 5-2 for the correct voltmeter connections and proceed with the following tests:

1. Measure the emitter voltage. Compare your measurement to the voltage listed on the schematic diagram. A correct emitter voltage reading generally indicates that the transistor is working properly. If you are in doubt as to the condition of the transistor after measuring the emitter voltage, proceed with the following test.



IN CIRCUIT TRANSISTOR TESTING
FIGURE 5-2

2. Measure the base-emitter junction bias. The voltage measured across a forward biased junction should be approximately 0.3 volts for a germanium transistor and 0.6 volts for a small signal silicon transistor.

3. Check for amplifier action by shorting the base to the emitter with a soldering aid while monitoring the collector voltage.* The transistor should cut off (not conduct emitter to collector) because the base-emitter bias is removed. The collector voltage should rise to near the supply level. Any difference is the result of leakage current through the transistor. Generally, the smaller the leakage current the better the transistor. If no change occurs in the collector voltage when the base-emitter junction is shorted the transistor should be removed from the circuit and checked with an ohmmeter or a transistor tester.

4. Use a 100 ohm load resistor if the collector DC resistance is too low to develop much DC voltage. This 100 ohm value does not affect the stage characteristics and by measuring the voltage developed across it, the collector current is indirectly measured.

CAUTION

Be careful when connecting test leads to in-circuit transistors. Operating transistors can be ruined by shorting the base to the collector and, in some circuit configurations, the emitter to ground.

*Not recommended for high level stages under driving conditions.

5.2.4 OHMMETER REQUIREMENTS FOR OUT OF CIRCUIT TRANSISTOR TESTING

Only high quality ohmmeters should be used to measure the resistance of transistors. Many ohmmeters of both VOM and electronic types have short circuit current capabilities in their lower ranges that can be damaging to semiconductor devices. A good "rule of thumb" is to never measure the resistance of a semiconductor on any ohmmeter range that produces more than 3 milliamperes of short circuit current. Also, it is not advisable to use an ohmmeter that has an open circuit voltage of more than 1.5 volts.

The following steps should be performed to determine the ohmmeter short circuit current:

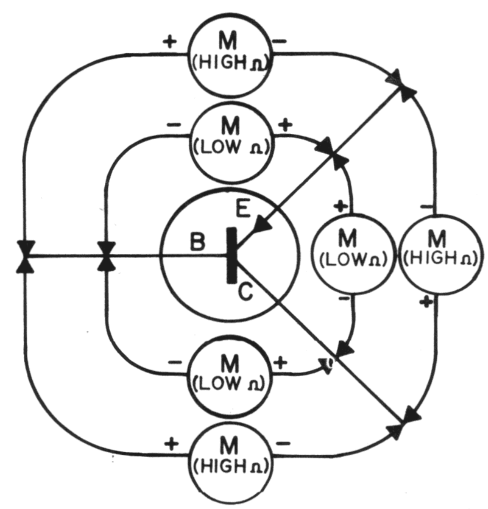
1. When the ohmmeter test probes are shorted together (measuring the forward resistance of a diode or the base-emitter junction of a transistor amounts to the same thing) the meter deflects full scale and the entire battery voltage appears across a resistance that we will designate as R1. The current through the probes is the battery voltage divided by the resistance of R1. A very easy method is available for determining the value of R1. Look at the exact center of the ohmmeter scale. Your reading is the value of R1 on the Rx1 range.

2. The only other unknown required to calculate the short circuit current of an ohmmeter is the internal battery voltage. Let's take a well known meter that has a center scale reading on the ohms scale of 4.62 and a battery voltage of 1.5 volts. Its short circuit current can be calculated by using Ohm's Law. Dividing 1.5 volts by 4.62 ohms equals a short circuit current of 324 mA on the Rx1 range. Obviously, the Rx1 range of this meter cannot be used to measure the resistance of semiconductors. When the value of R1 is known for the Rx1 it can then be determined for any range by multiplying R1 by the multiplier value of the range. The value of R1 for the Rx10 range of a meter with an R1 value on the Rx1 range of 4.62 ohms is 4.62 x 10 or 46.2 ohms. The short circuit current on the Rx10 range can then be calculated: 1.5 volts divided by 46.2 ohms equals 32.5 mA. By using this method, the lowest safe range for measuring semiconductor resistance may be determined for any ohmmeter.

Remember that you should not measure any semiconductor resistance on any ohmmeter range which produces more than three milliamperes of short circuit current.

5.2.5 OUT OF CIRCUIT TRANSISTOR TESTING

Turn the transceiver voltage off, disconnect at least two of the three element leads on the suspected detective transistor and refer to Figure 5-3.



OUT OF CIRCUIT TRANSISTOR
RESISTANCE MEASUREMENTS
FIGURE 5-3

Polarities shown in Figure 5-3 are for PNP transistor types. For NPN transistor types, reverse the meter lead polarity.

Small Signal Germanium (PNP)

Connect the positive meter lead to the emitter and the negative lead to the base. Approximately 300 to 400 ohms should be measured. Move the negative meter lead to the collector. Approximately 5K to 50K ohms should be measured. If either meter reading is near zero or infinity, the transistor can be considered defective.

Power Germanium (PNP)

Connect the positive meter lead to the emitter and the negative lead to the base. Approximately 20 to 50 ohms should be measured. Move the negative meter lead to the collector. Approximately 30 to 500 ohms should be measured. If either meter reading is near zero or infinity, the transistor can be considered defective.

Silicon (PNP)

Connect the positive meter lead to the emitter and the negative lead to the base. Approximately 500 to 2K ohms should be measured. Move the negative meter lead to the collector. Approximately 25K to infinity should be measured. If the emitter to base reading is near zero or infinity, the transistor can be considered defective. If the emitter to collector reading is near zero, the transistor can be considered defective. It is sometimes difficult to determine if an open exists from emitter to collector, since normal readings are near infinity.

5.3 RECEIVER TROUBLESHOOTING

NOTE

It should be noted that chassis ground is not common in some stages (microphone input and audio stages Q7 and Q8). Therefore, care must be taken when connecting test instruments and in some cases, test instrument power plugs must be "floated" or ungrounded.

5.3.1 RECEIVER CURRENT DRAIN

a. Connect a 1.5 ampere current meter in series with the positive voltage lead.

b. Press an available channel switch button. Set the volume control for maximum volume and the squelch control for minimum squelch.

c. Check the total receiver current drain.

   1. Typical receiver current drain should measure approximately 400 mA with no signal input.

5.3.2 RECEIVER OVERALL GAIN TEST

a. The relative receiver condition can be quickly checked by performing a receiver overall gain test.

b. Proceed as follows to perform a receiver overall gain test.

   1. Connect the RF signal generator to the antenna connector through a 6 dB pad. Set the RF signal generator output for 1 μV, modulated with 1 kHz at 30%.

   2. Set the RF signal generator frequency for 27.085 MHz (channel 11) and the transceiver volume control full on with channel 11 selected.

   3. With an audio voltmeter connected across the speaker terminals, a voltmeter indication of at least 0.775 volts (0 dB) should be indicated. A typical reading of +12 dB is common.

   4. If the preceding test indicates problems, use the following information to systematically troubleshoot the receiver.

5.3.3 OSCILLATOR, MIXER AND CERAMIC FILTER

a. Oscillator Q3 can be checked for proper starting by connecting the DC voltmeter to the emitter of Q3. A typical voltage reading of approximately 0.8 VDC should be measured. Remove the "R" crystal. The emitter voltage reading should drop to approximately 0.7 VDC.

   1. If oscillator Q3 fails to start every time, readjust T3.

   2. Substitute a non-starting crystal with a known good one.

b. Measure the RF injection voltage at the emitter of mixer Q2.

   1. A typical reading of approximately 100 mVRF to 150 mVRF should be measured.

   2. If the previous RF voltage readings are not measured, check Q2, Q3 and associated components.

c. The condition of ceramic filter Z4 can be checked by connecting a 455 kHz signal to the base of Q2 and monitoring the response curve after detector diode CR2 with an oscilloscope.

   1. Be sure to carefully check associated components before substituting Z4.

   2. Ceramic filter Z4 normally does not require realignment when replaced.

5.3.4 AUTOMATIC GAIN CONTROL (AGC)

a. Receiver performance can be evaluated by checking AGC characteristics and levels.

   1. Refer to receiver test setup, Figure 6-2, in the alignment section.